JC19 Rec'd PCT/PTO 08 MAR 2002

FORM PTO-1390 (REV 5-93) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER: **951/50488**

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO (if known, see 37 CFR 1.5): 10/070567

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/09183	20 September 2000	23 September 1999

TITLE OF INVENTION
SENSOR ARRANGEMENT

APPLICANT(S) FOR DO/EO/US
Wolfgang HAHN

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1.	X	This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.		
2.		This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371		
3.	X	This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay Examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).		
4.	X	A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.		
5.	X	A copy of the International Application as filed (35 U.S.C. 371(c)(2)).		
		a.	X	is transmitted herewith (required only if not transmitted by the International Bureau).
		b.		has been transmitted by the International Bureau
		c.		is not required, as the application was filed in the United States Receiving Office (RO/US)
6.	X	A translation of the International Application into English (35 U.S.C. 371(c)(2)).		
7.	X	Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))		
		a.		are transmitted herewith (required only if not transmitted by the International Bureau).
		b.		have been transmitted by the International Bureau.
		c.		have not been made; however, the time limit for making such amendments has NOT expired.
		d.	X	have not been made and will not be made.
8.		A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).		
9.	X	An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) (executed)		
10.	X	A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).		

Item 11. to 16. below concern other document(s) or information included:

11.	X	An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12.	X	An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13.	X	A FIRST preliminary amendment.
		A SECOND or SUBSEQUENT preliminary amendment.
14.	X	A substitute specification and marked-up copy thereof.
15.		A change of power of attorney and/or address letter.
16.	X	Other items or information:

a. 1 sheet of drawing showing a sole figure;
b. International Preliminary Examination Report w/Annexes; and
c. International Search Report.

23911
PATENT TRADEMARK OFFICE

U.S. APPLICATION NO (if known, see 37 CFR 1 5	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/070567	PCT/EP00/09183	951/50488

17. [X] The following fees are submitted:		CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO	$ 890.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482)	$ 710.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)	$ 740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor International search fee (37CFR 1.445(a)(2) paid to USPTO	$ 1040.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)	$ 100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$ 890.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		$	

Claims	Number Filed	Number Extra	Rate	
Total Claims	22 - 20 =	2	X $18.00	$ 36.00
Independent Claims	2 - 3 =	0	X $84.00	$
Multiple dependent claims(s) (if applicable)			+ $280.00	$

TOTAL OF ABOVE CALCULATIONS=	$ 926.00	
Applicant claims Small Entity Status (See 37 CFR §1.27) [ ] yes [ ] no. Reduction by 1/2 for filing by small entity, if applicable.	$	
SUBTOTAL =	$ 926.00	
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).	$	
TOTAL NATIONAL FEE =	$ 926.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28,3.31). $40.00 per property +	$ 40.00	
TOTAL FEE ENCLOSED =	$ 966.00	
	Amount to be: refunded	$
	Charged	$

a. [X] Two checks in the amount of $926.00 the filing fee and $40.00 for the assignment recording fee are enclosed

b. [ ] Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees, which may be required, or credit any overpayment to Deposit Account No. 05-1323. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
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SIGNATURE
Jeffrey D. Sanok
NAME
32,169
REGISTRATION NUMBER
March 8, 2002
DATE

JDS:pct

Attorney Docket: 951/50488
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WOLFGANG HAHN

Serial No.: NOT YET ASSIGNED PCT NO.: PCT/EP00/09183

Filed: CONCURRENTLY HEREWITH

Title: SENSOR ARRANGEMENT

PRELIMINARY AMENDMENT

Box PCT
Commissioner for Patents
Washington, D.C. 20231

Sir:

Please enter the following amendments to the specification and claims, as amended by way of Annexes to the International Preliminary Examination Report for PCT/EP00/09183, prior to the examination of the application during the U.S. National Phase.

IN THE SPECIFICATION:

Submitted herewith is a substitute specification and marked-up copy thereof which includes the changes made by way of the Annexes to the International Preliminary Examination Report.

IN THE CLAIMS:

Please cancel claims 1-9 presently in the application and substitute new claims 10-31 as follows:

10. (new) A motor vehicle sensor system for detecting an outer environment, the sensor system comprising:

at least two camera systems operable to image the outer environment; and

wherein each camera system operates in a different spectral region and is adjusted to a different focal distance.

11. (new) The sensor system according to claim 10, wherein one of said at least two camera systems is an infrared camera operating in an infrared range.

12. (new) The sensor system according to claim 10, wherein one of said at least two camera systems is a CCD camera.

13. (new) The sensor system according to claim 11, wherein another of said at least two camera systems is a CCD camera.

14. (new) The sensor system according to claim 12, wherein the CCD camera has a focal distance for detecting a close range.

15. (new) The sensor system according to claim 13, wherein the CCD camera has a focal distance for detecting a close range.

16. (new) The sensor system according to claim 14, wherein the focal distance of the CCD camera for the close range is adjusted to substantially correspond with a headlight cone range of a vehicle driven with its headlights on.

17. (new) The sensor system according to claim 15, wherein the focal distance of the CCD camera for the close range is adjusted to substantially correspond with a headlight cone range of a vehicle driven with its headlights on.

18. (new) The sensor system according to claim 10, further comprising an analyzing device operatively coupled with said at least two camera systems and receiving inputs therefrom.

19. (new) The sensor system according to claim 18, wherein said analyzing device includes means for performing differential contrast evaluation.

20. (new) The sensor system according to claim 18, further comprising:

a memory device in which is stored a visual range module; and

a visual range determining device operatively coupled to the memory device, said visual range determining device operating to draw a conclusion with respect to a visual range from information from the analyzing device.

21. (new) The sensor system according to claim 20, wherein said information from the analyzing device is differential contrast evaluation information.

22. (new) The sensor system according to claim 19, further comprising:

a memory device in which is stored a visual range module; and

a visual range determining device operatively coupled to the memory device, said visual range determining device operating to draw a conclusion with respect to a visual range from information from the analyzing device.

23. (new) The sensor system according to claim 22, wherein said information from the analyzing device is differential contrast evaluation information.

24. (new) A motor vehicle, comprising:

a vehicle body;

at least two camera systems arranged in a forward portion of the vehicle body for imaging areas in a traveling direction of the motor vehicle;

wherein each of said at least two camera systems has a different spectral operating region; and

further wherein each of said at least two camera systems is adjusted to a different focal distance in the traveling direction.

25. (new) The motor vehicle according to claim 24, wherein one of said at least two camera systems is an infrared camera operating in an infrared spectral region.

26. (new) The motor vehicle according to claim 25, wherein one of said at least two camera systems is a CCD camera.

27. (new) The motor vehicle according to claim 26, wherein another of said at least two camera systems is a CCD camera.

28. (new) The motor vehicle according to claim 27, wherein said CCD camera is adjusted to a focal distance corresponding with a headlight cone range of a headlight arranged in the forward area of the vehicle.

29. (new) The motor vehicle according to claim 28, wherein said CCD camera is adjusted to a focal distance corresponding with a headlight cone range of a headlight arranged in the forward area of the vehicle.

30. (new) The motor vehicle according to claim 24, further comprising an analyzing device operatively coupled to said at least two camera systems, said analyzing device outputting a display signal.

31. (new) The motor vehicle according to claim 30, further comprising a display arranged in an interior of the vehicle within a driver's viewing range, said display receiving the display signal from the analyzing device to provide environmental situation information to the driver.

<u>IN THE ABSTRACT</u>:

Please add an Abstract of the Disclosure submitted herewith on a separate page.

(Applicants' remarks are set forth herein below starting on the following page).

REMARKS

Entry of the amendments to the specification and claims, as amended by way of Annexes to the International Preliminary Examination Report for PCT/EP00/09183, before examination of the application in the U.S. National Phase is respectfully requested.

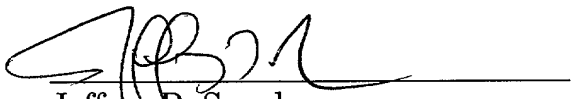
If there are any questions regarding this Preliminary Amendment or this application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If there are any questions regarding this Preliminary Amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #951/50488).

Respectfully submitted,

March 8, 2002



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--ABSTRACT OF THE DISCLOSURE

The invention relates to a sensor device for a motor vehicle used for detecting environmental parameters. Said sensor has at least one camera system. At least two camera systems are used, each operating in a different region of the electromagnetic spectrum in order to improve the functionality of such a sensor device.--

Attorney Docket: 951/50488
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WOLFGANG HAHN

Serial No.: NOT YET ASSIGNED PCT NO.: PCT/EP00/09183

Filed: CONCURRENTLY HEREWITH

Title: SENSOR ARRANGEMENT

SUBMISSION OF SUBSTITUTE SPECIFICATION

Box PCT
Commissioner for Patents
Washington, D.C. 20231

Sir:

Attached is a Substitute Specification and a marked-up copy of the original specification. I certify that said substitute specification contains no new matter and includes the changes indicated in the marked-up copy of the original specification.

Respectfully submitted,

March 8, 2002

Jeffrey D. Sanok
Registration No. 32,169

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JDS:pct

SENSOR ARRANGEMENT

BACKGROUND AND SUMMARY OF THE INVENTION

[0001] The invention relates to a sensor arrangement for a motor vehicle for detecting an environment having at least two camera systems.

[0002] A sensor system of this type can be used, for example, for assisting the driver, thus for supporting an operator of a vehicle. It supplies information on the environment and can be used in the domain of lane tracking, for a warning in the case of a lane deviation, or in the domain of automatic vehicle guidance.

[0003] In the case of such sensor systems, it is known to use so-called CCD cameras (CCD = charged coupled device). However, it should be taken into account that the functionality of driving assistance systems is limited when the sensor is already subjected to limitations when detecting the environment. In the case of CCD cameras, it is known that, especially in darkness and in the event of blinding due to an external light source, these cameras have a limited functionality. In this case, with respect to a blinding light in darkness, a superproportional limitation should be taken

into account, specifically when the CCD camera is adjusted to the environmentally caused illumination level. In the event another vehicle driving with switched-on lights is encountered, the image information is even largely destroyed by the oncoming blinding light sources.

[0004] The use of infrared cameras in such sensor arrangements is also known (compare technical journal: CAR AND DRIVER, October 1998). Infrared cameras obtain a heat image of the driving environment. In the heat image, all contours and objects are based on thermal contrasts. However, the information which is important for the driving task or for the reaction of a driver assistance system cannot always be obtained from the heat image.

[0005] European patent document EP 0 454 516 A1 describes an obstacle detection system having two video cameras, which generate images in the visible and in the infrared range. For generating images in the infrared range, CCD technology is used, for example. By means of a similar video camera, which can detect the entire spectrum, a differential signal is generated. This differential signal or differential image relates to the visual range, which is covered by the cameras and is based on the contrast of an object in this visual range. Japanese patent document JP-10 255019 also describes a

system with a CCD camera, which generates a visible image from the area in front of a vehicle. Furthermore, an infrared image is generated by an additional infrared camera. Based on the temperature information, a threshold for illuminated parts is generated, and an improved vehicle detection can take place on the basis of this threshold.

[0006] It is an object of the present invention to further develop a sensor arrangement of the above-mentioned type such that the environment can be detected essentially without any limitation of the functionality.

[0007] This object is achieved by a sensor arrangement for a motor vehicle for detecting the environment using at least two camera systems. Each camera system operates in a different spectral region. Each camera system is adjusted to a different focal distance.

[0008] An essential idea of the invention is to use at least two camera systems with respectively different spectral operating regions.

[0009] In this case, the different camera systems are equipped with different focal distances. For example, an infrared camera takes over the environmental detection in the

remote range because it is suitable for day and night use and is free from the effects of blinding. Freedom from blinding means, in this context, that the individual pixels are not overmodulated by the headlights of oncoming vehicles. The image information is therefore retained although the environment is completely dark. The close range is detected by the CCD camera. In particular, the CCD camera is adjusted such that it operates in a range which is illuminated by the front headlights when the vehicle headlights are switched on. Because of the higher illumination level, this measure reduces the susceptibility of the CCD camera to blinding effects.

[0010] According to a preferred embodiment, the sensor arrangement comprises a CCD-camera (charged coupled device) and a camera which operates in the infrared range. The infrared camera represents, for example, a meaningful supplementation of the sensor system (CCD), which is visual here, beyond its detection limits in the extended area in front of the driving environment.

[0011] When using camera systems with different focal distances and connected imaging scales, the driving environment, as a whole, can be detected better in both the close and remote ranges.

[0012] Another advantage of using two camera systems with different spectral operating regions consists of determining the atmospheric absorbance in the two spectral regions via differential contrast evaluation. By comparing the atmospheric absorbances, conclusions can be drawn with respect to fog or haze, which has a different effect on the sensor range. Furthermore, in conjunction with a visual range model stored in a vehicle, a driver's visual range can be determined from the detected absorbances. This information, in turn, can be made available to the driver, or control parameters can be adjusted in the vehicle as a function of the determined driver's visual range.

[0013] These and other advantageous embodiments are defined in the subclaims.

BRIEF DESCRIPTION OF THE DRAWING

[0014] The single figure will be explained in detail in the following and with reference to the single drawing. The figure of the single drawing is a schematic top view of a vehicle with a sensor system according to the invention arranged on the front of the vehicle.

DETAILED DESCRIPTION OF THE DRAWING

[0015] A vehicle 10 has two headlights 12, which illuminate a certain light range L during operation.

[0016] Between the two front headlights 12, two cameras are arranged, specifically in this case, an infrared camera 16 and a CCD camera (CCD = charged coupled device) 14. Both cameras 16 and 14 are aligned in the driving direction. The CCD camera is constructed and adjusted such that it essentially detects the range A, which is illuminated when the front headlights are switched on and therefore corresponds to the range L.

[0017] In contrast, the infrared camera 16 detects the environment particularly in the remote range B.

[0018] Both cameras 16, 14 are connected with a control and analyzing device 18. The control and analyzing device 18 emits a signal to a display 20, which is arranged in the interior of the vehicle within the driver's viewing range. The display 20 informs the driver of the environmental situation in the detected ranges.

[0019] In addition, but not shown in the figure, the control and analyzing device 18 can supply its information

also to other units in the vehicle, for example, to systems concerned with automatic vehicle guidance.

[0020] On the one hand, the control and analyzing device 18 forwards the information transmitted by the cameras 16 and 14 directly to the driver. It also carries out a differential contrast evaluation. As a result, the extinctions of the atmosphere can be determined in the two spectral regions. If a visual range model is also stored in the control and analyzing device 18, by way of the determined extinctions and by means of a differential contrast evaluation, a conclusion can also be drawn with respect to the driver's visual range.

[0021] This visual range and/or these extinctions can then be utilized for adapting control parameters or for recommending a vehicle speed to the driver.

[0022] However, for determining the extinction in the visible spectral region, another system, such as a LIDAR system may also be used.

[MOTOR VEHICLE SENSOR ARRANGEMENT FOR DETECTING AN ENVIRONMENT]

[The invention relates to a sensor arrangement for a motor vehicle for detecting an environment having at least one camera system.

A sensor system of this type can be used, for example, for assisting the driver, thus for supporting an operator of a vehicle. It supplies information on the environment and can be used in the domain of lane tracking, for a warning in the case of a lane deviation, or in the domain of automatic vehicle guiding.

In the case of such sensor systems, it is known to use so-called CCD cameras (CCD = charged coupled device). However, it should be taken into account that the functionality of driving assistance systems is limited when the sensor is already subjected to limitations when detecting the environment. In the case of CCD cameras, it is known that, especially in darkness and in the event of a blinding by an external light source, these cameras have a limited functionality. In this case, with respect to a blinding in darkness, a superproportional limitation should be taken into

account, specifically when the CCD camera is adjusted to the environmentally caused illumination level. In the event of encountering another vehicle driving with switched-on lights, the image information is even largely destroyed by the oncoming blinding sources.

The use of infrared cameras in such sensor arrangements is also known (compare technical journal: CAR AND DRIVER, October 1998). Infrared cameras take a heat image of the driving environment. In the heat image, all contours and objects are based on thermal contrasts. However, the information which is important for the driving task or for the reaction of a driver assistance system cannot always be obtained from the heat image.

It is an object of the present invention to further develop a sensor arrangement of the initially mentioned type such that a detection of the environment can take place essentially without any limitation of the functionality.

This object is achieved by means of the characteristics indicated in Claim 1.

An essential idea of the invention is to use at least two camera systems with respectively different spectral operating

regions.

According to a preferred embodiment, the sensor arrangement comprises a CCD-camera (charged coupled device) and a camera which operates in the infrared range. The infrared camera represents, for example, a meaningful supplementation of the sensor system (CCD), which is visual here, beyond its detection limits in the extended area in front of the driving environment.

According to another advantageous embodiment of the invention, the different camera systems are equipped with different focal distances. For example, the infrared camera takes over the detection of the environment in the remote range because it is suitable for day and night and is free of any blinding. Freedom from blinding means in this context that the individual pixels are not overmodulated by the headlights of oncoming vehicles. The image information is therefore retained although the environment is completely dark. The close range is detected by the CCD camera. In particular, the latter is adjusted such that it operates in a range which, when the vehicle lights are switched on, is illuminated by the front headlights. Because of the higher illumination level, this measure reduces the susceptibility of the CCD camera to blinding.]

SENSOR ARRANGEMENT

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to a sensor arrangement for a motor vehicle for detecting an environment having at least two camera systems.

A sensor system of this type can be used, for example, for assisting the driver, thus for supporting an operator of a vehicle. It supplies information on the environment and can be used in the domain of lane tracking, for a warning in the case of a lane deviation, or in the domain of automatic vehicle guidance.

In the case of such sensor systems, it is known to use so-called CCD cameras (CCD = charged coupled device). However, it should be taken into account that the functionality of driving assistance systems is limited when the sensor is already subjected to limitations when detecting the environment. In the case of CCD cameras, it is known that, especially in darkness and in the event of blinding due to an external light source, these cameras have a limited functionality. In this case, with respect to a blinding light in darkness, a superproportional limitation should be taken into account, specifically when the CCD camera is adjusted to

the environmentally caused illumination level. In the event another vehicle driving with switched-on lights is encountered, the image information is even largely destroyed by the oncoming blinding light sources.

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the area in front of a vehicle. Furthermore, an infrared image is generated by an additional infrared camera. Based on the temperature information, a threshold for illuminated parts is generated, and an improved vehicle detection can take place on the basis of this threshold.

It is an object of the present invention to further develop a sensor arrangement of the above-mentioned type such that the environment can be detected essentially without any limitation of the functionality.

This object is achieved by a sensor arrangement for a motor vehicle for detecting the environment using at least two camera systems. Each camera system operates in a different spectral region. Each camera system is adjusted to a different focal distance.

An essential idea of the invention is to use at least two camera systems with respectively different spectral operating regions.

In this case, the different camera systems are equipped with different focal distances. For example, an infrared camera takes over the environmental detection in the remote range because it is suitable for day and night use and is free from the effects of blinding. Freedom from blinding means, in

this context, that the individual pixels are not overmodulated by the headlights of oncoming vehicles. The image information is therefore retained although the environment is completely dark. The close range is detected by the CCD camera. In particular, the CCD camera is adjusted such that it operates in a range which is illuminated by the front headlights when the vehicle headlights are switched on. Because of the higher illumination level, this measure reduces the susceptibility of the CCD camera to blinding effects.

According to a preferred embodiment, the sensor arrangement comprises a CCD-camera (charged coupled device) and a camera which operates in the infrared range. The infrared camera represents, for example, a meaningful supplementation of the sensor system (CCD), which is visual here, beyond its detection limits in the extended area in front of the driving environment.

When using camera systems with different focal distances and [the] connected imaging scales, the driving environment, as a whole, can be detected better [as a whole] in both the close and [in the] remote [range] ranges.

Another advantage of using two camera systems with different spectral operating regions consists of determining

the [extinction of the atmosphere] atmospheric absorbance in the two spectral regions [by means of] via differential contrast evaluation. By comparing the [extinctions] atmospheric absorbances, conclusions can be drawn with respect to fog or haze, which has a different effect on the sensor range. Furthermore, in conjunction with a visual range model [filed] stored in a vehicle, a driver's visual range can be determined from the detected [extinctions] absorbances. This information, in turn, can be made available to the driver, or control parameters can be adjusted in the vehicle as a function of the determined driver's visual range.

These and other advantageous embodiments are defined in the subclaims.

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A vehicle 10 has two headlights 12, which illuminate a certain light range L during [the] operation.

Between the two front headlights 12, two cameras are arranged, specifically in this case, an infrared camera 16 and a CCD camera (CCD = charged coupled device) 14. Both cameras 16 and 14 are aligned in the driving direction. The CCD camera is constructed and adjusted such that it essentially detects the range A, which is illuminated when the front headlights are switched on and therefore corresponds to the range L.

In contrast, the infrared camera 16 detects the environment particularly in the remote range B.

Both cameras 16, 14 are connected with a control and analyzing device 18. The control and analyzing device 18 emits a signal to a display 20, which is arranged in the interior of the vehicle [interior in] within the driver's viewing range. The display 20 informs the driver of the environmental situation in the detected ranges.

In addition, but not shown in the figure, the control and analyzing device 18 can supply its information also to other units in the vehicle, for example, to systems [which concern an] concerned with automatic vehicle guidance.

On the one hand, the control and analyzing device 18 forwards the information transmitted by the cameras 16 and 14 directly to the driver. It also carries out a differential contrast evaluation. As a result, the extinctions of the atmosphere can be determined in the two spectral regions. If a visual range model is also [filed] stored in the control and analyzing device 18, by way of the determined extinctions and by means of a differential contrast evaluation, a conclusion can also be drawn with respect to the driver's visual range.

This visual range and/or these extinctions can then be utilized for adapting control parameters or for recommending a vehicle speed to the driver.

However, for determining the extinction in the visible spectral region, another system, such as a LIDAR system may also be used.

MOTOR VEHICLE SENSOR ARRANGEMENT FOR DETECTING AN ENVIRONMENT

The invention relates to a sensor arrangement for a motor vehicle for detecting an environment having at least one camera system.

A sensor system of this type can be used, for example, for assisting the driver, thus for supporting an operator of a vehicle. It supplies information on the environment and can be used in the domain of lane tracking, for a warning in the case of a lane deviation, or in the domain of automatic vehicle guiding.

In the case of such sensor systems, it is known to use so-called CCD cameras (CCD = charged coupled device). However, it should be taken into account that the functionality of driving assistance systems is limited when the sensor is already subjected to limitations when detecting the environment. In the case of CCD cameras, it is known that, especially in darkness and in the event of a blinding by an external light source, these cameras have a limited functionality. In this case, with respect to a blinding in darkness, a superproportional limitation should

be taken into account, specifically when the CCD camera is adjusted to the environmentally caused illumination level. In the event of encountering another vehicle driving with switched-on lights, the image information is even largely destroyed by the oncoming blinding sources.

The use of infrared cameras in such sensor arrangements is also known (compare technical journal: CAR AND DRIVER, October 1998). Infrared cameras take a heat image of the driving environment. In the heat image, all contours and objects are based on thermal contrasts. However, the information which is important for the driving task or for the reaction of a driver assistance system cannot always be obtained from the heat image.

It is an object of the present invention to further develop a sensor arrangement of the initially mentioned type such that a detection of the environment can take place essentially without any limitation of the functionality.

This object is achieved by means of the characteristics indicated in Claim 1.

An essential idea of the invention is to use at least two camera systems with respectively different spectral operating regions.

According to a preferred embodiment, the sensor arrangement comprises a CCD-camera (charged coupled device) and a camera which operates in the infrared range. The infrared camera represents, for example, a meaningful supplementation of the sensor system (CCD), which is visual here, beyond its detection limits in the extended area in front of the driving environment.

According to another advantageous embodiment of the invention, the different camera systems are equipped with different focal distances. For example, the infrared camera takes over the detection of the environment in the remote range because it is suitable for day and night and is free of any blinding. Freedom from blinding means in this context that the individual pixels are not overmodulated by the headlights of oncoming vehicles. The image information is therefore retained although the environment is completely dark. The close range is detected by the CCD camera. In particular, the latter is adjusted such that it operates in a range which, when the vehicle

lights are switched on, is illuminated by the front headlights. Because of the higher illumination level, this measure reduces the susceptibility of the CCD camera to blinding.

When using camera systems with different focal distances and the connected imaging scales, the driving environment can be detected better as a whole in the close and in the remote range.

Another advantage of using two camera systems with different spectral operating regions consists of determining the extinction of the atmosphere in the two spectral regions by means of differential contrast evaluation. By comparing the extinctions, conclusions can be drawn with respect to fog or haze, which has a different effect on the sensor range. Furthermore, in conjunction with a visual range model filed in a vehicle, a driver's visual range can be determined from the detected extinctions. This information, in turn, can be made available to the driver, or control parameters can be adjusted in the vehicle as a function of the determined driver's visual range.

These and other advantageous embodiments are defined in the subclaims.

The single figure will be explained in detail in the following and with reference to the single drawing. The figure of the single drawing is a schematic top view of a vehicle with a sensor system according to the invention arranged on the front.

A vehicle 10 has two headlights 12 which illuminate a certain light range L during the operation.

Between the two front headlights 12, two cameras are arranged, specifically in this case, an infrared camera 16 and a CCD camera (CCD = charged coupled device) 14. Both cameras 16 and 14 are aligned in the driving direction. The CCD camera is constructed and adjusted such that it essentially detects the range A which is illuminated when the front headlights are switched on and therefore corresponds to the range L.

In contrast, the infrared camera 16 detects the environment particularly in the remote range B.

Both cameras 16, 14 are connected with a control and analyzing device 18. The control and analyzing device 18 emits a

signal to a display 20 which is arranged in the vehicle interior in the driver's viewing range. The display 20 informs the driver of the environmental situation in the detected ranges.

In addition, but not shown in the figure, the control and analyzing device 18 can supply its information also to other units in the vehicle, for example, to systems which concern an automatic vehicle guidance.

On the one hand, the control and analyzing device 18 forwards the information transmitted by the cameras 16 and 14 directly to the driver. It also carries out a differential contrast evaluation. As a result, the extinctions of the atmosphere can be determined in the two spectral regions. If a visual range model is also filed in the control and analyzing device 18, by way of the determined extinctions and by means of a differential contrast evaluation, a conclusion can also be drawn with respect to the driver's visual range.

This visual range and/or these extinctions can then be utilized for adapting control parameters or for recommending a speed to the driver.

However, for determining the extinction in the visible spectral region, another system, such as a LIDAR system may also be used.

Sensor Arrangement

CLAIMS:

1. Sensor arrangement for a motor vehicle for detecting the environment by means of at least one camera system, characterized in that at least two camera systems (14, 16) are provided which each operate in different spectral regions.

2. Sensor arrangement according to Claim 1, characterized in that each camera system (14, 16) is adjusted to a different focal distance.

3. Sensor arrangement according to Claim 1 or 2, characterized in that one camera system (16) operates in the infrared range.

4. Sensor arrangement according to one of Claims 1 to 3, characterized in that one camera system (14) comprises a CCD camera.

5. Sensor arrangement according to Claim 4,

characterized in that the CCD camera (14) is used for detecting the close range.

6. Sensor arrangement according to Claim 5, characterized in that the CCD camera (14) is adjusted such that it detects the range of a headlight cone of a vehicle driving with switched-on lights.

7. Sensor arrangement according to one of the preceding claims,
characterized in that an analyzing device (18) is provided which is connected with all camera systems.

8. Sensor arrangement according to Claim 7, characterized in that the analyzing device (18) is constructed for the differential contrast evaluation.

9. Sensor arrangement according to Claim 7 or 8, characterized in that a memory device is provided in which a visual range module is stored, and in that a device is provided by means of which a conclusion can be drawn with respect to the visual range from information of the analyzing device,

particularly of the differential contrast evaluation.

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

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Zur Erklärung der Zweibuchstaben-Codes, und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

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(54) Title: SENSOR DEVICE FOR A MOTOR VEHICLE USED FOR DETECTING ENVIRONMENTAL PARAMETERS

(54) Bezeichnung: KRAFTFAHRZEUGSENSORANORDNUNG ZUR UMGEBUNGSERFASSUNG

(57) Abstract: The invention relates to a sensor device for a motor vehicle used for detecting environmental parameters. Said sensor has at least one camera system. At least two camera systems are used, each operating in a different region of the electromagnetic spectrum in order to improve the functionality of such a sensor device.

(57) Zusammenfassung: Die Erfindung betrifft eine Sensoranordnung für ein Kraftfahrzeug zur Umgebungserfassung mit zumindest einem Kamerasystem. Zur verbesserten Funktionalität einer solchen Sensoranordnung wird vorgeschlagen, zumindest zwei Kamerasysteme zu verwenden, die jeweils in unterschiedlichen Spektralbereichen arbeiten.

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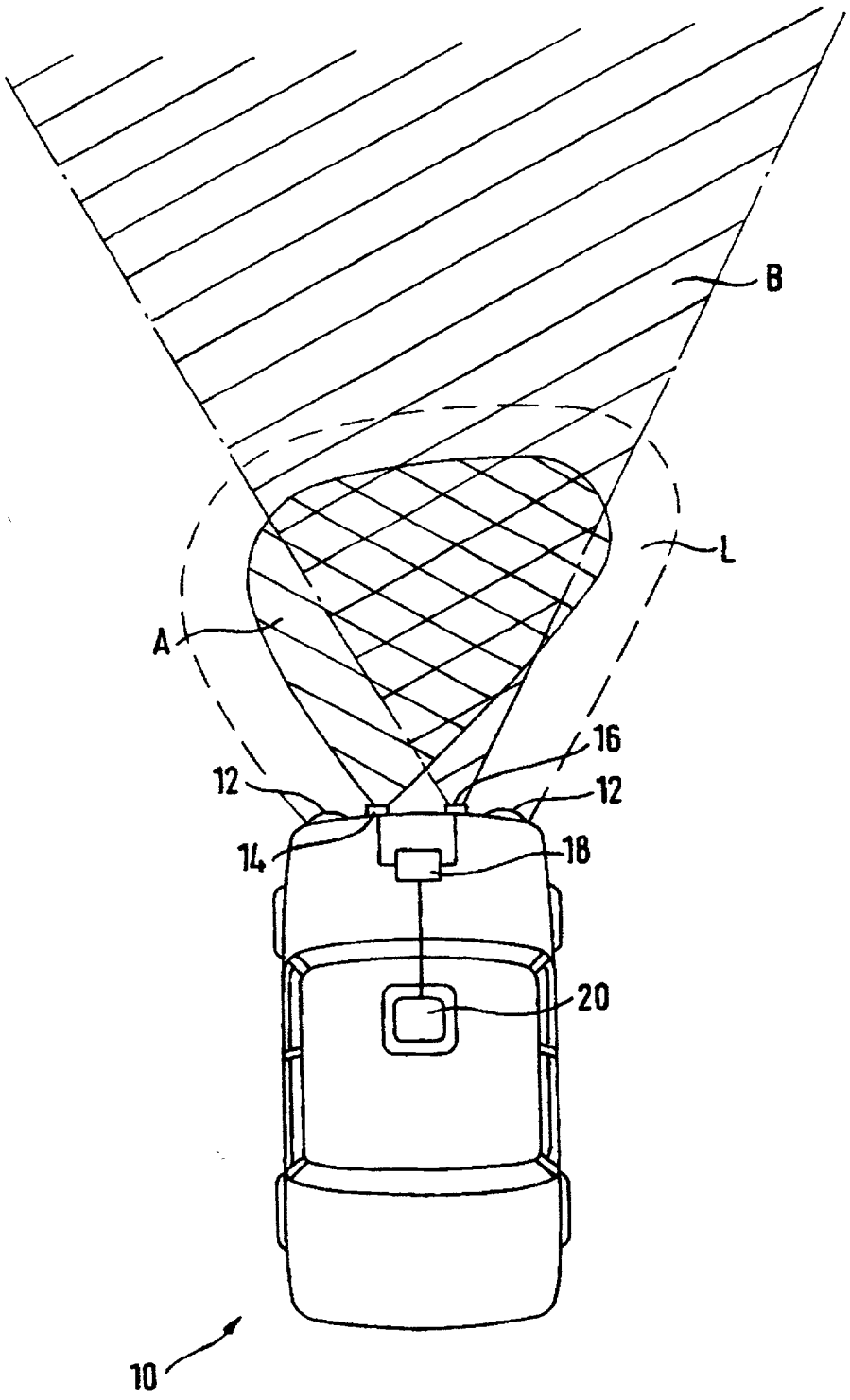

PP 199 45 588 US

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (includes Reference to PCT International Applications)	ATTORNEY'S DOCKET NUMBER **951/50488**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SENSOR ARRANGEMENT

the specification of which (check only one item below):

[ ] is attached hereto.

[ ] was filed as United States application
Serial No.
on
And was amended
on _____ (if applicable).

[X] was filed as PCT international application
Number PCT/EP00/09183 ✓
on 20 September 2000 ✓
and was amended under PCT Article 19
on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations. §1.56(a).

I hereby claim foreign priority benefits under Title 35, United State Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT indicate PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
GERMANY ✓	199 45 588.0 ✓	23 September 1999 ✓	[X] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No

Combined Declaration For Patent Application and Power of Attorney (Continued) (includes Reference to PCT international Applications	ATTORNEY'S DOCKET NUMBER **951/50488**

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national of PCT international filing date of this application:

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U.S. APPLICATIONS		STATUS *(Check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (IF ANY)		

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

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203	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true: and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
X Wolfgang Hahn		
DATE 10.01.2002	Date	DATE